Remarks

The Office Action dated November 15, 2007 has been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Subsequent to entry of this amendment, Claims 1, 3-7, 9-10, and 20-22 are pending in this application. Claims 1, 3-7, 9-10, and 20-22 stand rejected. Claims 2, 8, 11-19 and 23-27 have previously been cancelled.

In accordance with 37 C.F.R. 1.136(a), a two month extension of time is submitted herewith to extend the due date of the response to the Office Action dated November 15, 2007, for the above-identified patent application from February 15, 2008, through and including April 15, 2008. In accordance with 37 C.F.R. 1.17(a), authorization to charge a deposit account in the amount of $460.00 to cover this extension of time request also is submitted herewith.

The rejection of Claims 1 to 22 under 35 U.S.C. § 103(a) as being unpatentable over Patterson (US 3,892,625) in view of Yasuyaki (JP 06-289178) is respectfully traversed.

Applicants submit that the Section 103 rejection of the pending claims is not proper because a *prima facie* case of obviousness has not been established. Particularly, and as explained below, the combination of the teachings of Patterson and the teachings of Yasuyaki do not describe nor teach all the recited limitations in Claim 1 of the present application.

Claim 1 of the present application recites "[a] nuclear reactor core comprising: a plurality of fuel assemblies, each said fuel assembly comprising a fuel bundle, a lower tie plate coupled to a lower end of said fuel bundle, a fuel support coupled to said lower tie plate, and a main coolant flow channel comprising a coolant inlet, said main coolant flow channel extending from said coolant inlet through said fuel support and said lower tie plate into a main body of said fuel

bundle; and a coolant flowing through said plurality of fuel assemblies; said plurality of fuel assemblies arranged into at least three regions within said core, each said region includes a portion of said plurality of fuel assemblies, each portion comprising more than one of said plurality of fuel assemblies; each said main coolant flow channel further comprising a means of controlling a flow of coolant through said main coolant flow channel so that the flow of coolant through said main coolant flow channels of said fuel assemblies located in a particular region are substantially the same, and that the coolant flow through said fuel assemblies in each said region is different from the coolant flow through said fuel assemblies in each other region, said means of controlling said flow of coolant through said main coolant flow channel comprising a plurality of orifices and a plurality of restriction devices, each said inlet of each said main coolant flow channel includes one orifice located therein, each said restriction device detachably coupled to a lower end of said lower tie plate and comprising a plurality of openings extending through said restriction device, each said main coolant flow channel having its own means of controlling coolant flow that is separate from means of controlling coolant flow for each other main coolant flow channel."

Patterson does not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Patterson does not describe nor suggest that the plurality of fuel assemblies are arranged into at least three regions within the core with each region including a portion of the plurality of fuel assemblies, where each portion includes more than one of the plurality of fuel assemblies. Rather, Patterson describes that the fuel assemblies are arranged into two regions in the core. Specifically, at Col. 3, lines 20-25, Patterson, referring to Figure 1, describes that "[i]n the region located outside line A are the restraint assemblies 18 and reflector assemblies,

whereas in the region located between lines A and B are located the radial blanket fuel assemblies or breeder assemblies, and in the region inside line B are located the fuel assemblies". Applicants submit that restraint assemblies 18 are not fuel assemblies, but rather flow control devices to control the flow of coolant to a number of fuel assemblies located in the region between A and B. Further, the Office Action dated October 15, 2004, at page 3 admits that Patterson does not teach three core flow regions.

Furthermore, Applicants disagree with the suggestion at page 9 of the 4/3/07 Office Action that Patterson describes "three core flow regions because as shown by Figure 2 below, the flow through EACH radial blanket fuel assembly the examiner has labeled as 1, 2 and 3 will indeed be different due to different size of the orifice that lets water into each fuel assembly." Applicants submit that as noted above Patterson describes at Col. 3, lines 20-25, that the radial blanket fuel assemblies are located in the region located between lines A and B shown in Figure 1. What the Office Action is referring to as three core flow regions is just three different fuel assemblies within one core region located between A and B as shown in Figure 1. Applicants also submit that because the 4/3/07 Office Action stipulates that the flow through each radial blanket fuel assembly is different, Patterson teaches away from the recitation of Claim 1 of the present application that each main coolant flow channel have a means of controlling a flow of coolant through said main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same. In addition, Applicants disagrees with the assertion at page 3 of the current Office Action that "the Examiner considers each different fuel assembly as a different region within the region between A and B. Particularly, Claim 1 has been amended to recite that " each said region

includes a portion of said plurality of fuel assemblies, each portion comprising more than one of said plurality of fuel assemblies." Applicants submit that because each region includes more than one fuel assembly, the Examiner's interpretation of Patterson that considers each different fuel assembly as a different region does not teach the recitations of Claim 1. Support for the amendment of Claim 1 is found in paragraph [0023] which describes that there are *fuel bundles* (plural) in each region. Particularly, paragraph [0023] describes:

> The power output of fuel bundles 46 that are located in each of the regions of core 22 are different. Particularly, edge region 70 contains fuel bundles 46 that produce the lowest power. Fuel bundles 46 that are located in middle region 74 produce higher power than fuel bundles 46 that are located in edge region 70, and fuel bundles 46 located in central region 76 produce higher power than fuel bundles 46 located in middle region 74.

Further, Patterson et al. do not describe nor suggest a fuel assembly that includes a orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate, with the main coolant flow channel extending from the coolant inlet through the fuel support and the lower tie plate into the fuel bundle main body. Rather, Patterson describes that flow of coolant through several blanket fuel assemblies are controlled by one restraint assembly (a flow control device), see Figure 2. The main coolant flow channel of each blanket fuel assembly does not include its own separate means of controlling the coolant flow through the channel located in the inlet of the main coolant flow channel where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly.

Yasuyaki is cited for teaching three flow rate regions. Yasuyaki is not cited for, and does not teach that main coolant flow channel of each fuel assembly has its own means of controlling

coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel and that each fuel assembly includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Rather, as best understood from the English language abstract, Yasuyaki describes tripartite flow rate regions of a reactor core. The cooling material is pumped by a single electromagnetic pump through the core. Yasuyaki describes that each flow rate in the regions 2-4 is adjusted to an optimum state. However, Yasuyaki does not describe nor suggest that each fuel assembly includes a main coolant flow channel and a separate means of controlling a flow of coolant through the main coolant flow channel where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Yasuyaki only describes a pump for controlling the coolant flow through regions 2-4.

Patterson and Yasuyaki, alone or in combination, do not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Patterson and Yasuyaki, alone or in combination, do not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises an orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel

assembly. As explained above, Patterson does not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel includes a separate means of controlling a flow of coolant through the main coolant flow channel that is located in the inlet of the main coolant flow channel, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly, and Yasuyaki does not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel includes a separate means of controlling a flow of coolant through the main coolant flow channel that is located in the inlet of the main coolant flow channel, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Further, as explained above, Patterson teaches away from the limitation that each main coolant flow channel have a means of controlling a flow of coolant through said main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same. Combining the teachings of Patterson and Yasuyaki does not describe nor suggest a reactor core where each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel includes its own means of controlling a flow of coolant through the main coolant flow channel that is located in the inlet of the main coolant flow channel, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Therefore combining the teachings of Yasuyaki with the teachings of Patterson does not describe

nor suggest all the limitations of Claim 1. Accordingly, Applicants submit that independent Claim 1 is patentable over Patterson and Yasuyaki, alone or in combination.

Claims 2, 8, and 11-19 have previously been cancelled

Claims 3-7, 9-10, and 20-22 depend from independent Claim 1. When the recitations of dependent Claims 3-7, 9-10, and 20-22 are considered in combination with the recitations of Claim 1, Applicants respectfully submit that Claims 3-7, 9-10, and 20-22 likewise are patentable over Patterson and Yasuyaki, alone or in combination.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 1-22 be withdrawn.

The rejection of Claims 1, 3-7, 9, 10 and 20-22 under 35 U.S.C. § 103(a) as being unpatentable over the Background Of The Invention of the present application in view of Congdon et al. (US 5,149,491), Patterson, or Yasuyaki, and further in view of Matzner et al. (US 5,384,814) or Kilian (US 5,524,031) is respectfully traversed.

Applicants submit that the Section 103 rejection of the pending claims is not proper because a *prima facie* case of obviousness has not been established. Particularly, and as explained below, the combination of the teachings of Background Of The Invention of the present application with the teachings of Congdon et al., Patterson, or Yasuyaki, and the teachings of Matzner et al. or Kilian do not describe nor teach all the recited limitations in Claim 1 of the present application.

As explained above Patterson and Yasuyaki, alone or in combination do not describe nor suggest a nuclear reactor as recited in Claim 1. Particularly, Patterson and Yasuyaki, alone or in combination, do not describe nor suggest that each fuel assembly in the core includes a main

coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises an orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly.

The Background Of The Invention describes at paragraph [0008] that

> Known BWRs include two orifice regions usually designated as peripheral and center. The peripheral region includes all fuel locations around the periphery of the core, and the center region includes the remainder of the locations. The inlet orifice design limits the peripheral region flow per fuel element to about half of the flow per fuel element of the center region. Limiting the peripheral flow by this magnitude permits the very low power peripheral fuel elements to saturate the coolant flow, but the exit quality and average voids are still much lower than for the other higher power region. This uneven exit quality and average void can produce inefficient steam separation and nuclear moderation.

Applicants submit that the Background Of The Invention of the present application does not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises a coolant orifice located in the coolant inlet and a

restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. There is no description or suggestion in the Background Of The Invention that the means of controlling coolant flow in a region permits the coolant flow to be substantially the same through each fuel assembly in the region where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Particularly, the Background Of The Invention does not describe nor suggest restriction devices detachably coupled to a lower end of the lower tie plate of the fuel assemblies.

Congdon et al. describe a nuclear reactor core arrangement that includes mounting fuel bundles on orificed support stubs mounted on the core support. As described in Col. 4, lines 26-43, the fuel bundles are divided into three groups, a group of fresh bundles, a group of bundles at mid-life, and a group of bundles near the end of their useful life. The orificed support stubs are likewise divided into three groups, small-orificed stubs, large-orificed stubs, and peripheral stubs, which also have small orifices. The small-orificed stubs and the peripheral stubs define 1 inch apertures through the core support plate, while the large-orificed stubs define 2 inch apertures through the core support plate.

Congdon et al. do not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Congdon et al. do not describe nor suggest a each main coolant flow channel of fuel assembly includes a means of controlling a flow of coolant through the main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region. Also, Congdon et al. do not describe nor suggest a fuel assembly that includes

a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate. Rather, Congdon et al. describe multiple regions that include various sized orificed stubs to control the flow of coolant through the fuel assemblies. Particularly, the small-orificed stubs and the peripheral stubs define 1 inch apertures through the core support plate, while the large-orificed stubs define 2 inch apertures through the core support plate. Applicants submit that because both the small-orificed stubs and the peripheral stubs define 1 inch apertures, the coolant flow in those regions will inherently be the same. Therefore, Congdon et al. does not describe nor suggest that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region. As admitted by the 4/3/07 Office Action at page 3, Congdon et al. do not describe nor suggest a restriction device detachably coupled to the lower tie plate in addition to the orificed-stub.

Accordingly, Applicants submit that combining the teachings of the Background Of The Invention of the present application with the teachings of Congdon et al., Patterson, or Yasuyaki, does not describe nor suggest al the recitations of independent Claim 1 of the present application.

Matzner et al. describes a lower tie plate strainer for boiling water reactors. The strainer is a three dimensional that includes a perforated plate mounted in a three dimensional structure such as a dome, cylinder, pyramid, inverted pyramid ,or corrugated construction. Matzner et al. specifically teaches that the strainer is not a restriction device and teaches away from the use of the strainer to control the flow through the fuel assembly. Particularly, Matzner et al. describes at Col. 4, lines 22-28, that "[a]s a consequence of this three dimensional grid construction, the total flow-through area of the perforations in the metal plate should be at least as great as this flow area through the bundle without this debris catcher, and does not introduce significantly

additional pressure drop in the lower tie plate assembly." Also, Matzner et al. teaches that "if apparatus for preventing debris entrainment into the fuel bundles is going to be utilized, appreciable change in overall fuel bundle pressure drop should be avoided."

Accordingly, Applicants submit that combining the teachings of the Background Of The Invention of the present application with the teachings of Congdon et al., Patterson, or Yasuyaki, and with the teachings of Matzner et al. does not describe nor suggest al the recitations of independent Claim 1 of the present application.

Kilian describes a method of retrofitting an irradiated nuclear fuel assembly that includes removing a portion of the inlet nozzle and installing a debris filter. The debris filter includes a filter cap ring a debris filter support ring and filter media secured to the support ring. Notably, Kilian does not describe nor suggest a restriction device having a plurality of openings extending therethrough.

Accordingly, Applicants submit that combining the teachings of the Background Of The Invention of the present application with the teachings of Congdon et al., Patterson, or Yasuyaki, and with the teachings of Kilian does not describe nor suggest al the recitations of independent Claim 1 of the present application.

At least for the reasons set forth above, Applicants submit that Claim 1 is patentable over the Background Of The Invention of the present application in view of Congdon et al., Patterson, or Yasuyaki, and further in view of Matzner et al. or Kilian.

Claims 3-7, 9-10, and 20-22 depend from independent Claim 1. When the recitations of dependent Claims 3-7, 9-10, and 20-22 are considered in combination with the recitations of Claim 1, Applicants respectfully submit that Claims 3-7, 9-10, and 20-22 likewise are patentable

over the Background Of The Invention of the present application in view of Congdon et al., Patterson, or Yasuyaki, and further in view of Matzner et al. or Kilian.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 3-7, 9-10, and 20-22 be withdrawn.

The rejection of Claims 1, 3-7, 9, 10 and 20-22 under 35 U.S.C. § 103(a) as being unpatentable over Congdon et al. (US 5,149,491) in view of Matzner et al. (US 5,384,814) or Kilian (US 5,524,031) is respectfully traversed.

Applicants submit that the Section 103 rejection of the pending claims is not proper because a *prima facie* case of obviousness has not been established. Particularly, and as explained below, the combination of the teachings Congdon et al. with the teachings of Matzner et al. or the teachings of Kilian do not describe nor teach all the recited limitations in Claim 1 of the present application.

Congdon et al. do not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Congdon et al. do not describe nor suggest a each main coolant flow channel of fuel assembly includes a means of controlling a flow of coolant through the main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region. Also, Congdon et al. do not describe nor suggest a fuel assembly that includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate. Rather, Congdon et al. describe multiple regions that include various sized orificed stubs to control the flow of coolant through the fuel assemblies.

Particularly, the small-orificed stubs and the peripheral stubs define 1 inch apertures through the core support plate, while the large-orificed stubs define 2 inch apertures through the core support plate. Applicants submit that because both the small-orificed stubs and the peripheral stubs define 1 inch apertures, the coolant flow in those regions will inherently be the same. Therefore, Congdon et al. does not describe nor suggest that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region. As admitted by the Office Action at page 3, Congdon et al. do not describe nor suggest a restriction device detachably coupled to the lower tie plate in addition to the orificed-stub.

Matzner et al. describes a lower tie plate strainer for boiling water reactors. The strainer is a three dimensional that includes a perforated plate mounted in a three dimensional structure such as a dome, cylinder, pyramid, inverted pyramid ,or corrugated construction. Matzner et al. specifically teaches that the strainer is not a restriction device and teaches away from the use of the strainer to control the flow through the fuel assembly and as such it would not be obvious to one skilled in the art to combine the teachings of Matzner et al. with the teachings of Congdon et al. to control coolant flow rate. Specifically, Matzner et al. describes at Col. 4, lines 22-28, that "[a]s a consequence of this three dimensional grid construction, the total flow-through area of the perforations in the metal plate should be at least as great as this flow area through the bundle without this debris catcher, and does not introduce significantly additional pressure drop in the lower tie plate assembly." Also, Matzner et al. teaches that "if apparatus for preventing debris entrainment into the fuel bundles is going to be utilized, appreciable change in overall fuel bundle pressure drop should be avoided."

Accordingly, Applicants submit that combining the teachings of Congdon et al. with the teachings of Matzner et al. does not describe nor suggest al the recitations of independent Claim 1 of the present application.

Kilian describes a method of retrofitting an irradiated nuclear fuel assembly that includes removing a portion of the inlet nozzle and installing a debris filter. The debris filter includes a filter cap ring a debris filter support ring and filter media secured to the support ring. Notably, Kilian does not describe nor suggest a restriction device having a plurality of openings extending therethrough. Claim 1 of the present application recites "each said restriction device detachably coupled to a lower end of said lower tie plate and comprising a plurality of openings extending through said restriction device."

Accordingly, Applicants submit that combining the teachings of Congdon et al. with the teachings of Kilian does not describe nor suggest al the recitations of independent Claim 1 of the present application.

At least for the reasons set forth above, Applicants submit that Claim 1 is patentable over of Congdon et al. in view of Matzner et al. or Kilian.

Claims 3-7, 9-10, and 20-22 depend from independent Claim 1. When the recitations of dependent Claims 3-7, 9-10, and 20-22 are considered in combination with the recitations of Claim 1, Applicants respectfully submit that Claims 3-7, 9-10, and 20-22 likewise are patentable over Congdon et al. in view of Matzner et al. or Kilian.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 3-7, 9-10, and 20-22 be withdrawn.

In view of the foregoing amendments and remarks, all the claims now active in this application are believed to be in condition for allowance. Favorable action is respectfully solicited.

Respectfully submitted,

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